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The Education Report

There is no subject more controversial than education, due, we believe, to the pertinacious interference of the amateur, especially if some proposed legislation cuts across either his religious convictions or pet theory. Much controversy would be removed if there were more clear thinking as to what ends were sought in the institution of an educational system. The first conception was literacy in the widest sense of the term, and to-day the non-achievement of this standard by an applicant for a job will invariably bring a letter to the editor of the local newspaper pointing out the enormous yearly cost and signed "Disgusted." Now a new basis has been found. Literacy is taken for granted, and now the object is to make future generations thoroughly good citizens. In this enlightened age, organised sections of the community are rightly expected to place before the Government reports which will help the legislature to satisfy the wishes of the majority, and not to penalise any particular profession or industry through inadvertence. The foundry industry now has before it a Report* on the Education and the Workshop Training of Young Foundrymen, prepared by the Education Committee of the Institute of British Foundrymen. It is now being considered by the Council of Ironfoundry Associations, and it will be interesting to have their reactions, for we are not at all convinced that it will receive unanimous approbation. There is a body of opinion which believes that 15½ years is too old to start an apprenticeship to a complicated and highly skilled trade, especially when there is every likelihood of the training period being interrupted by a term in the armed forces of the Crown. We can assure this type of critic from personal observation that so far as military service is concerned, it does not adversely affect the ultimate skill of the moulder, but it has the unfortunate effect of making the "officer" class—for in some cases there are special corps for university engineering graduates—rather unpractical. We half suspect that recommended training at technical schools will be modified by the educationalists, as many are so keen on some time being given to civics. This is an important feature of American school life, and its inclusion here is designed to get beyond the older basis of literacy. It is a subject which needs careful direction, for otherwise it can become an instrument of party politics, as was and is the case in Germany. In such a case the object of literacy would be preferable, because it happens to be the sole tool requisite for the true genius to rise to the top. Of course, reliance may be placed on post-employment education to receive the dose of civics at the Young Peoples Colleges at which the industrial neophyte must attend one day a week up to the age of eighteen. It is perfectly certain that the C.F.A. will share the anxiety expressed in the Report as to from where all the qualified teachers are to come. It is not only in foundry technology that this weakness is evident, for too much reliance has been placed upon the quite untenable notion that the gaining of a degree in the arts or science quite naturally confers upon the graduate the rare gift of imparting knowledge. Already there is criticism of the idea that the Technical Committee should prepare standardised notes for the teaching of foundry practice, yet we see no other course to follow until there be available a method of ascertaining the worth of teachers without waiting for the publication of examination results of the students. The Report, which has been produced under the difficulty of envisaging post-war conditions, is a credit to the Institute, and especially to Mr. S. H. Russell, who for so long has devoted so much of his spare time to this thankless task of improving the general level of intelligence within the industry.

* Price 2s. 6d. from St. John Street Chambers, Deansgate, Manchester, 3.

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NOTES FROM THE BRANCHES

London. Mr. Dan Sharpe, the president of the Institute, was the guest of honour at an informal luncheon party, held at the Waldorf Hotel on December 16, immediately prior to a meeting of the Branch Council. Mr. H. W. Lockwood presided, and was supported by five past-presidents, the chairman of the East Anglian Section (Mr. F. Tibbenham). Altogether 18 were present and the only other guest Mr. John Bolton, the acting secretary. Energetic steps are to be taken to maintain the interest in the work of the Institute aroused by the recent course of lectures held in Slough. The Council expressed their gratitude to Mr. W. C. Devereux and Mr. E. J. Pike for their help and encouragement, which have contributed so largely to the outstanding success of this development.

The honorary secretary, Mr. V. C. Faulkner, was able to report another record year, the membership having now achieved the 450 mark. The financial position was equally satisfactory, whilst no less than 19 technical meetings had been held.

INSTITUTE OF VITREOUS ENAMELLERS

DR. G. T. MARTIN has resigned from the staff of the British Cast Iron Research Association, where for several years he has been in sole charge of the vitreous enamelling department. He is also relinquishing his position as Honorary Secretary of the Institute of Vitreous Enamellers. At the last council meeting of this body he was presented with cheques from the Institute and from those present. He is to take up an industrial appointment. Mr. W. Thomas, A.I.C., of the London House of Metters, Limited, the well-known Australian foundry concern, has been elected Honorary Secretary of the Institute. His address is Bank House, High Street, Rickmansworth,

PUBLICATION RECEIVED

The Magnesium (Grinding of Castings and other Articles) Order, 1943, S.R. & O., No. 268. Issued by H. M. Stationery Office, York House, Kingsway, London, W.C.2. Price 1d.

This order details the requirements to be met when grinding magnesium alloys castings. The details cover the provision of hood, duct and fan for the safe removal of dust arising from grinding or polishing processes, and also of a scrubber in which the dust-laden air from the fan is drenched with water. The exhaust system has to function for five minutes before operations are started, and there must be automatic means to prevent work being carried out when the exhaust is not in operation. Rules for sludge disposal and the repeated prohibition of ferrous tools are included, and special protective clothing is to be provided and worn.

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(*Concluded from page* 8.)

peratures to which iron must be heated to obtain finest graphite structure increased as the sum of the carbon and silicon percentage increased. When iron is heated above these temperatures, either coarse graphite or the objectionable graphite-fine-ferrite (graphite eutectic) structure has been observed, with inferior mechanical properties as a result.

In view of the above, it is pertinent to draw attention to Norbury's attempt to classify graphitisation phenomena into two general types, *viz.*, "normal" graphitisation and "supercooled" graphitisation, mixed graphitisation being a combination of both these types. "Normal" graphite is in the form of regularly distributed flakes, while the "supercooled" variety is characterised by fine graphite flakes arranged according to a regular system known as "graphite eutectic" structure, which is very often entirely ferritic. Under-cooling is common in all types of iron, but the typical ferrite-fine-graphite structure is particularly noticeable in thin sectioned work and at the skin of heavier castings. This structure has been proved inferior in combating corrosive wear under lubricated conditions encountered in internal combustion engines. In the production of pistons, piston rings, cylinder liners, etc., it is, therefore, found necessary to exercise close control over such factors as cupola air supply, chemical composition (particularly total carbon and phosphorus, and the use of carbide stabilising alloys), the furnace temperatures obtained, time the metal is held in the furnace well, and the inoculation process, in order to eliminate this trouble. Recently a remarkable series of experiments, in which the graphite structure of superheated iron was modified at will by treating the molten metal with titanium, followed by carbon-dioxide, hydrogen and other gases, indicated that the technique of superheating and inoculation is only in its infancy.

CATALOGUE RECEIVED

Copper and Copper Alloys. The Revere Copper & Brass Incorporated, 230, Park Avenue, New York, N.Y., have sent us a 44-page well-illustrated catalogue which contains the latest information of the more important copper, brass, bronze and nickel alloys, and the forms in which they are marketed. Data are given as to the chemical and mechanical properties of each alloy, as well as their typical uses. The arrangement of the brochure is particularly effective. First of all the six main types of heavy non-ferrous alloys are covered in respect to properties, followed by a catalogue of Revere productions divided into 13 sections ranging from sheet, through forgings and anodes to tubes. Finally four pages are devoted to welding technique. It is interesting to note that this concern was founded during the War of Independence by Paul Revere, whose famous "ride" is an epic in American history.

ELEMENTS OF CONTROL IN THE GREY IRON FOUNDRY*

Engineering Properties of Cast Irons and their Improvement through Foundry Control

By BRIAN RUSSELL

Modern metallurgical research has been fully alive to the potentialities of grey iron, and has shown the way to vastly improve both the properties and performance of this material. To-day's trend in the iron-foundry is towards higher engineering properties, which can only be obtained by close control over materials, melting and moulding practice. To-day it is quite common to find foundries producing regularly from the cupola, cast iron with strengths upwards of 30 tons per sq. in. to be cast into crankshafts, blanking and forging dies and machine tool members; whereas only a few years back engineers would have shaken their heads at the idea of cast iron operating successfully under such exacting service conditions. Until recently, unless a drawing or forming die was made of costly tool steel, it was considered an inferior product. Nowadays, however, it is common practice to build high-grade dies, in high-duty cast iron, which may be heat-treated to provide tensile strengths in the region of 31 tons per sq. in., with compressive strength of about 110 tons per sq. in.

In addition to the saving in material cost, it gives extremely satisfactory die operation by reason of the dense graphite bearing nature of this iron. Graphite here prevents, or minimises, galling, which is one of the worst enemies of the die-maker, and a smooth long life surface is attained during operation of the die. An Australian made high-duty iron shell die, as used in the Ajax forging machine, has produced 15,000 forgings before refacing was found necessary, and it has now been twice refaced, giving a production of 15,000 each time. Prior to the adoption of high-duty iron in this machine, the dies were made of hot-die steel and were completely worn out after 5,000 forgings. The iron die was cast within 0.010 of an inch of finished size.

Prejudice against the use of a casting in such an application as a crankshaft has been founded on the conviction that castings, and particularly iron ones, are necessarily weak and unreliable. That this is a misconception when applied to high-duty iron as produced under properly controlled conditions, is shown by the fact that cast-iron shafts have recently replaced steel forgings in medium power, medium speed oil engines, and in several high-speed transport units. It has been claimed by one manufacturer that this iron with a cast strength of 27 tons per sq. in. compares favourably with a 40-ton steel under actual working conditions as a crankshaft. Without some knowledge of the mechanical properties of high-strength irons, one might well question the truth of this statement. The explanation is partly tied up in a property of cast iron called "crackless plasticity." From the economic standpoint, iron shafts cost considerably less than forgings to produce, as there is far less machining, no cold straightening, usually no necessity for hardening crank pins or main bearings, while in addition these latter may be cored out to save weight. Again, there is less engine vibration with a cast-iron shaft, due to its superior damping properties.

Mechanical Properties

In order to give satisfactory life under stress in service, any engineering component is required to possess a combination of properties, and diagnosis of past failures has established what particular properties are vital to the successful functioning of the component under working conditions. Taking the above case of a crankshaft, the chief properties required are high strength in tension and torsion, good fatigue resistance to withstand stress alternation, high impact resistance to combat shock loads, high damping capacity to reduce resonance stresses, and good surface wear properties on journals. In another component, however, good fatigue, or else shock properties, may be of less importance than, say, the property of intense surface hardness, to withstand severe abrasion.

Tensile Strength and Elastic Properties

The average cast iron, owing to its structural make-up, differs from steel in that it acts elastically only at very low stresses, above which stress permanent set takes place. It follows that E for cast iron is of a very low order, and is particularly difficult to determine with any accuracy. Generally speaking, the E value increases in cast iron as the tensile strength increases, and it has now been established that high-duty iron possesses true elastic properties, and, as a material of construction, is comparable with steel castings and forgings. Another property important to the designer is the yield point, or that stress at which an appreciable stretching of the material occurs, without the addition of more force. In the case of steel, considerable plastic deformation occurs between the yield point and the stress at which ultimate fracture takes place, but soft grey iron, with no definite elastic limit, exhibits a continual series of yield points from very low loads, right up to the point of fracture. It has been found, however, that irons with high tensile strength possess a yield point relatively higher than that of cast steel, so that, whereas in the case of steel plastic deformation commences at 40 to 50 per cent. of the tensile strength, high-duty iron is free from permanent set-up to about 80 per cent. of its tensile strength. In this connection, one American authority quotes

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* Abridgement of a paper read before the Institute of Australian Foundrymen, Mr. W. Main presiding.

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the following typical figures for high-duty iron (Meehanite Research Inst.): *True elastic limit*, 7.6 tons per sq. in.; *yield point*, 20.1 tons per sq. in.; *tensile strength*, 24.6 tons per sq. in. It will be seen that a comparison of the tensile strength of these two materials is not a fair basis on which to design, because the usable strength is determined by the yield point.

Hardness

This property is of greatest importance in the production control of metals, as it is closely related to machinability, wear, and in the case of steel and various other alloys, bears a direct relationship to tensile strength and other mechanical properties. The significance of the term hardness depends on the method of measurement adopted, which may be based on resistance of the metal to indentation, to scratching, to cutting, or to abrasive wear. The most popular methods of measurement depend upon the resistance of metal to indentation under an applied load, using either a steel ball, as in the well-known Brinell test, or a diamond indentor, as in the Rockwell and Vickers methods. To use these standard tests as a guide to wearability or machinability is only practicable, however, under specific conditions, owing to the many contributing factors involved in any revaluation of these properties.

The main factors governing hardness of iron castings are composition, cooling rate, and heat-treatment. The hardness of grey iron bears no direct relationship to tensile strength and other properties, as in the case of steel, which fact is explained by the difference in structural make-up of the two materials. Nevertheless, given an intimate knowledge of an iron born of long experience, such as is often obtained in repetition work, it is frequently possible to establish a relationship between the hardness and certain other properties, such as tensile strength, elasticity and machinability, thereby permitting a simple, speedy, hardness test to act as "watch dog" in the inspection department. The hardness test is also a very useful means of establishing the degree of sensitivity of an iron to changes of section, *i.e.*, the extent to which solidity and structural uniformity are affected by different rates of cooling in different sections.

Fatigue

It has often been said, and with some truth, that metals get tired, and it is, after all, only logical to expect that a part subjected to severe dynamic stress day after day, should sooner or later develop some internal complaint of a mortal nature. Breakdown of metals by fatigue is the commonest cause of engineering failure, and results from repeated alternation or reversal of stress in service. But there is another property of metals (later more fully discussed) which bears closely on this subject. "Notch sensitivity" is intimately related to the fatigue strength, in that stress concentrations at notches will often initiate minute cracks which are gradually extended by the flexing action resulting upon alternation of stress, until a stage is reached where fracture occurs in a brittle manner. The typical appearance provided by a fatigue fracture gave rise to the misconception, popular amongst engineers a few years ago, that metals can "crystallise" in service. The ability of materials to withstand alternating stress is expressed as the endurance limit, which is defined as "a limiting stress below which metal will withstand, without fracture, an indefinitely large number of cycles of stress" (C.M. Handbook, 1940).

Test apparatus in which a load is applied to a rotating specimen has been developed to measure fatigue properties of metals—alternate bending generally being used for testing cast irons. The endurance limit of grey iron is influenced both by the amount and size of the graphite flakes and by the nature of the matrix, a normal figure quoted being 45 per cent. of the tensile strength. While a more ductile metal like steel possesses a higher endurance limit than cast iron, the lower notch sensitivity of the latter makes for good fatigue life, and this fact has been amply demonstrated by the close similarity in results obtained from fatigue tests in notched and unnotched specimens of grey iron as compared with a large variation in the case of steel specimens.

Notch Sensitivity and Crackless Plasticity

It is common practice to facilitate the breakage of a brittle material, such as glass, by means of scratching the surface with a file or diamond. This "notch sensitivity" is exhibited by many materials, and is particularly noticeable in some steel parts where notches are provided by oil channels, keyways, sharp fillets, screw threads, tool marks, etc. Many soft and ductile steels have failed in service in a brittle manner owing to the weakening influence of a notch.

Grey cast iron, possessing as it does an infinitely large number of small notches in the form of graphite flakes, is far less affected by additional notches in the form of keyways, etc., than is steel, which may have its endurance limit halved by the presence of such a notch. It is apparent that the function of graphite here is to dissipate stress throughout the casting, thereby preventing local concentrations of stress from starting small cracks, which would later lead to fracture by fatigue. In recent literature this property of a material to withstand sudden overstress without fracturing has been aptly called "crackless plasticity." High-strength irons containing, as they do, less graphite, might be expected to be more sensitive to the presence of notches than irons of lower strength, and, in practice, this has been found to be the case.

Although the relative notch sensitivity of different materials is difficult to determine, it is a property of considerable importance to the designing engineer, and one which helps to explain the apparently anomalous success of high-duty cast iron in such an application as a crankshaft.

Impact Strength

"Toughness" conveys the meaning of being difficult to break under bending, twisting, hammering, or shock,

and as such is looked upon as the opposite of "brittleness." A common method of measuring shock or impact resistance is to permit a heavy weight to break a specimen of the material either by single blow, or repeated blows, the amount of energy required to cause fracture being proportional to the impact resistance or toughness of the material. Results obtained from standard apparatus such as Izod, Charpy and Stanton are difficult to interpret, and, although there is no recognised impact test for cast iron, several bodies, including the B.C.I.R.A., are at present developing a machine to evaluate this property.

It is a well known fact that ductile materials, *e.g.*, steel or malleable iron, have far better shock properties than a comparatively brittle material like cast iron. The distribution size and amount of graphite flakes are found to have a profound influence on impact values, so that it is rational to expect high-duty irons to exhibit far better impact properties than ordinary commercial grey iron. Laboratory tests have shown this to be the case, and confirmation is provided by instances of remarkable performance under shock loads in service.

Damping Capacity

By damping capacity is meant the ability of a material to absorb or dampen vibrational energy. It is believed that the internal friction of the metal converts this energy into heat, which is then dispersed. Owing to its graphite content, grey iron possesses excellent damping properties in the lower range of stress, properties much superior to those of steel—one good reason why machine tool builders use this material wherever possible. For instance, in the use of a machine tool, such as a precision grinder, the function of which is to produce work to a high limit of accuracy, vibration, set up by motors, transmission, etc., would be transmitted to the work with disastrous effects upon accuracy, were it not for the ability of the cast-iron bed and other component parts of the machine to absorb these vibrations.

It has been established that damping capacity of cast iron is related to the shape and distribution of graphite flakes, and it is also known that high damping capacity is usually associated with low notch sensitivity, with correspondingly improved fatigue properties. In a Paper by Brophy and Parker in the A.S.T.M. Transactions, 1936, the authors state that "the property of damping is of greatest importance in the control of the deflection and whipping of rotating shafts, and the surging of springs. In any metal the damping capacity may vary greatly, depending upon such factors as stress, chemical composition, structure, heat-treatment, mechanical work, and especially temperature." Possibly the most effective apparatus for evaluating this property of a metal is the Foeppl-Perts machine, in which a round test bar is set in torsional vibration, its free vibration being recorded on a moving chart until it becomes stationary when all energy has been dissipated. The width of the recorded vibration is then measured and the damping capacity calculated from the readings made.

Strength in Torsion, Shear and Compression

A knowledge of torsion and shear strength of grey iron becomes important in the design of crankshafts, camshafts, etc. Little data are available on the torsion properties of cast iron, but shear strength has been investigated by Bolton, Jolly, Shaw, and others. Results obtained by these investigators were in agreement in as much as the ratio between shear and tensile strength was found to decrease as the strength of the metal increased. The Cast Metals Handbook, 1940, gives shear strength of cast iron as 1.0 to 1.6 times the tensile strength; the narrower ratio applying to the higher strength irons, and the wider ratio to the weaker irons. The range of shear strengths for grey irons is given as 10 to 35 tons per sq. in. Compressive strength is another important engineering property, and is usually taken as 3 to 5 times the tensile strength.

Wear Resistance

Wear of metal has been defined by one authority as "the undesired gradual change in dimension in service under frictional pressure," and by another as "mechanical or physical surface disintegration due to moving contact with another metal or material resulting in removal of surface layers of the metal, causing dimensional change which affects the functioning of the parts involved, and, if continued, will eventually result in complete failure" (H. W. Gillett, Battelle Memorial Inst., Cast Metals Handbook, 1940).

Wear cannot be regarded as an inherent property of metals, since it depends to a considerable extent upon the conditions of service, which latter, by introducing a number of conflicting factors, serves to make any investigation of wear a rather complicated matter. Such properties as hardness, toughness, microstructure, friction, corrosion resistance, and also conditions of temperature, lubrication, pressure, speed and surface smoothness, play their part, either individually or collectively, in determining wearability. From which it will be evident that every problem of wear must be considered on its own merits. In view of the large number of factors likely to cloud the issue, it is generally accepted that accelerated wear testing apparatus is only of limited value in assessing wearability of metals, and that reliable results are only obtained from tests done under actual service conditions. Mechanical wear may be classified under two general headings, *viz.*, abrasion and erosion; in very many wear applications the responsibility is shared by both of these causes.

Abrasion

Dealing briefly with the more usual cause—abrasion—as applied to cast iron, there are two classes of abrasion: (*a*) hard abrasion, and (*b*) metal to metal wear under both dry and lubricated conditions.

(*a*) *Hard Abrasion.*—In hard wear applications such as ball mill liners, chilled car wheels, wearing plates, etc., the primary requisites are intense surface hardness to resist penetration of the metal by hard abrasive particles, toughness to prevent pieces of the metal

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being torn away in service, and in the case of rolling wear on wheels, freedom from surface spalling. White cast irons, owing to their high hardness, are found satisfactory for this duty, the best irons of this type, combining as they do freedom from brittleness with a Brinell hardness exceeding 600, which compares favourably with manganese steel.

(*b*) *Metal to Metal Wear.*—Grey iron possesses a unique quality of wear resistance in parts subjected to sliding wear, such as gear teeth, dies, or bearings. This fact is largely due to the presence of graphite flakes, which, by reason of their greasy nature and their ability to retain lubricants, provide the excellent non-galling bearing surface so suitable for service in the internal combustion engine. *Erosion* occurs in iron, pipes, pump parts and hydraulic equipment, and is due to the mechanical wearing action of fluids, often carrying solid particles in suspension, impinging at high velocity against the metal. The action is similar in principle to the scrubbing action of flood waters against a river bank. Frequently this type of wear is supplemented by electrolytic action, owing to the presence of corrosive agents in the liquid being handled. *Cavitation.*—In passing it might be as well to draw attention to one other type of wear—cavitation. This is brought about by a combination of corrosion and collapse of vacuo in pump parts. Austenitic irons have high resistance to this form of wear.

Control Factors for Improved Material

In order to improve the mechanical properties of grey iron, it is required so to control conditions in the foundry that:—

(*a*) The amount and size of the graphite flakes be reduced, at the same time controlling their shape, form, and distribution. (It has been established that a short, squat, curly form of flake is more conducive to high strength than if graphite be present in long thin veins.)

(*b*) The hard and brittle constituent, free cementite, be absent, all the combined carbon being present as pearlite.

(*c*) The relatively soft, low strength free ferrite constituent be absent, all ferrite being present in the form of pearlite.

(*d*) The amount of brittle steadite present be as low as possible.

Now, in order to produce a casting with such a desirable high-duty structure, it is essential to suit the chemical composition to the section thicknesses of the job, assuming, of course, other factors, such as melting conditions, pouring temperatures, etc., to be constant. The usual method adopted to reduce the quantity and size of graphite flakes is to add steel scrap to the furnace charge. If operation of the furnace is properly controlled, this will have the desired effect of reducing phosphorus and carbon, and, of course, with lower total carbon, there is less graphite present.

In order to attain the object of producing a matrix consisting solely of the tough pearlite constituent, it is necessary to ensure that the two components of pearlite, *viz.*, cementite and ferrite, are present in the correct proportion, *viz.*, 1.7. Any excess of either constituent over the amount required to form pearlite results in lower strength. The two main factors controlling the relative amounts of ferrite and cementite occurring in a normal cast iron are: (*a*) Chemical composition of the metal, and (*b*) rate at which the casting cools.

Chemical Composition

Soft grey iron contains about 3.5 per cent. of carbon, 2 to 3 per cent. of silicon, up to 1 per cent. of manganese, 1 per cent. of phosphorus, and usually not more than 0.15 per cent. sulphur. The practical effect of altering the percentage of any one of these impurities is fairly well understood by foundrymen; for example, for a given section, an increase in silicon or total carbon will result in a softer, more open-grained iron, while the reverse procedure, that of reducing silicon or carbon, tends to give a closer grained, harder metal. In the same way, increased phosphorus is known to lower the freezing temperature, thereby increasing fluidity, while manganese is apt to cause machining troubles if much over 1 per cent., or much under 0.3 per cent. However, the reason behind these observed changes in fracture, etc., can be understood only by consideration of the changes wrought upon the internal structure of the metal by such alteration of composition.

Silicon.—Briefly it can be said that silicon acts as a softener by promoting decomposition of the cementitic carbon into its ultimate components, iron and graphite, during the process of cooling in the mould. The general effect upon the microstructure of raising the silicon content is, therefore, to produce more and larger graphite flakes, thereby reducing the combined carbon, thus effecting an increase in the amount of free ferrite, at the expense of pearlite. The presence of silicon is not detected under the microscope, owing to the fact that it is dissolved in ferrite as the compound Fe-Si. Apart from its influence upon the form the carbon shall take, silicon also affects the solubility of carbon in the iron.

Manganese is usually present in amounts well in excess of that required to neutralise the effects of sulphur (1 part of S. to 1.72 parts of Mn), and this excess manganese, partly dissolved in the ferrite, and partly associated with cementite, renders dissociation of the latter more difficult, thereby opposing the softening action of silicon.

Sulphur.—Australian pig-irons are very low in sulphur, seldom exceeding 0.1 per cent., and provided that sufficient manganese is present, almost the whole of the sulphur will be in the innocuous Mn-S form. In the absence of sufficient manganese, sulphur exists as sulphide of iron, which has a hardening and embrittling effect upon the metal.

Phosphorus combines with iron to form iron phosphide, which in turn forms the low melting point eutectic, steadite, made up of either iron-phosphide and

iron, or iron phosphide—iron carbide and iron, depending upon the cooling conditions, and chemical composition. Although the main function of phosphorus in cast iron is to increase fluidity, in certain small castings, such as piston rings, the presence of a large quantity of steadite distributed evenly throughout the metal enhances the wearing quality without materially affecting the mechanical properties. If segregated, however, phosphorus is a frequent cause of hard spots and machining troubles; in fact, many cases of hard spots for which free cementite has received the blame, have been found on examination to be caused by the ternary phosphide constituent. Anyone interested in the influence of phosphorus compounds upon the machinability of cast iron is recommended to consult an article by J. Boyer, January, 1939, "Metals and Alloys." According to Boyer, sulphur appears to be the important factor in stabilising the carbide present in this ternary eutectic. Considerable controversy exists as to the harmful effects or otherwise of phosphorus upon the strength of cast iron. Nevertheless, it is a golden rule when aiming for high strength or shock resistance to keep phosphorus as low as practicable.

Total Carbon.—While there is a considerable measure of control over the structure and properties of cast iron by means of varying the amount of total carbon alone, the form that the carbon will assume, *i.e.*, the proportion of combined carbon to graphite, is regulated primarily by silicon. Thus, when making up mixtures in the ironfoundry, the basic importance of the carbon-silicon relationship, in the control of structure, should be well understood.

Cooling Rates

The main points to be considered here are:—(1) Capacity of mould material; (2) rate and temperature of pouring; and (3) size and shape of casting. When molten iron is poured into a mould, most of the heat given out in cooling must be dissipated by mould and cores so that, other factors being equal, the greater the heat conductivity of mould the more rapidly will the casting cool. A familiar demonstration of this is seen in the local densening effect of chills, or in the fine grained structure of castings made in permanent metal moulds. Then, too, the temperature of mould at time of pouring, the quantity of moisture in the mould, and rate of pouring, can markedly affect cooling rate, and thereby influence the combined carbon and structure. Evidence of the former is furnished by comparing the various hot and cold mould processes, while the latter effect is illustrated by the familiar coarsening of fractures close to dry-sand core surfaces in small castings.

Without going into the mechanism of freezing, it is proposed briefly to consider the relationship existing between pouring temperature, section thickness and micro-structure. Consideration of the influence of section thickness upon cooling rate must take into account the volume of metal to be cooled, and the shape of the casting, *i.e.*, its surface area for dissipation of heat. The actual cooling rate is directly related to the ratio of volume to surface area, that is to say, for two castings of the same weight, but of different shape, that one will cool the faster which presents the greater mould surface area to the cooling metal. However, for practical purposes, control of structure is obtained by regulating the chemical composition to suit what might be called the "critical" section thickness of the casting. By "critical" section thickness is meant here, that part of the casting which, by reason of its smaller section or faster cooling, imposes limitations upon the properties obtainable in heavier sections of the same job, *e.g.*, in a casting of varying wall thickness, strength or wearing properties of thicker sections may be governed by the necessity of retaining machinability in lighter sections as in the case of some auto-cylinder blocks. On the other hand, if a casting is to withstand hard wear in service, the founder may be confronted with exactly the opposite problem, that of preventing thickest sections from becoming unmachinable. Special irons of the alloy and inoculated types possess low wall thickness sensitivity, *i.e.*, they are less sensitive to cooling rate, so that they are more or less immune from the above troubles. In this connection, Bolton has pointed out that the lower the total carbon content, the less sensitive is the iron to change of section, while an increase in silicon has the opposite effect, as its action on graphitisation depends on time as well as on temperature and concentration.

Graphite formation is accompanied by evolution of heat, the effect being to slow up cooling rate through the graphitisation range of temperature. Lower carbon iron will, therefore, cool more rapidly through this range than high total carbon, high graphite irons, which is one reason why the former are denser and sounder than the latter when cast into the same sections, and also show greater strength, hardness and structural uniformity in heavy sections (assuming, of course, that effective feeding has been obtained).

Composition and Cooling

The above remarks concerning cooling rate influences are to indicate the fundamental relationship existing between the composition, cooling rate, and structure. The fact must not be overlooked, however, that lack of soundness or the presence of internal stresses in a casting can outweigh these considerations. Furnacemen well know that it is not always a simple matter to obtain the nice balance desired between composition and cooling rate, that is to say, to adjust the silicon-carbon ratio to suit the sections to be cast so as to avoid, on the one hand, a soft, open-grained casting due to the presence of coarse graphite and free ferrite, and, on the other hand, machining troubles from chilled edges due to the presence of excess cementite.

The interdependent nature of the two variables, rate of cooling and chemical composition, may be further emphasised by the fact that two irons of widely different analysis can be made to provide similar mechanical properties in the "as-cast" condition, simply by controlling the cooling rate. To illustrate this, one may compare an iron made by the Thyssen-Emmel process with one made by the Lanz-

Control in the Grey Iron Foundry

Perlit method. In the former case, a high-silicon iron (silicon 2.60 per cent., total carbon 2.75 per cent.) is poured into a cold mould, while Lanz-Perlit pours a low-silicon iron (Si less than 1 per cent., total carbon 3.1 per cent.) into a heated mould. Both methods provide high-strength iron, possessing a similar type of structure under the microscope, *viz.*, small curly graphite flakes in fine-grained pearlite. Thus, in the case of irons used for general engineering purposes (*i.e.*, excluding heat- and corrosion-resisting types), the chemical composition is important only in so far as it affects the microstructure, which in turn governs the mechanical properties of the casting. At the same time, however, it must not be overlooked that a normal relationship existing between composition and cooling rate may be profoundly influenced by changes made to charge make-up, to melting conditions, to superheating, and pouring temperatures, or to inoculation technique.

Inoculation and Superheating

Inoculation is a process by which the normal freezing characteristics of cast iron are modified by means of making a small addition of another metal or compound to the molten iron just prior to pouring. The mechanical properties are, under certain conditions, profoundly improved by the late addition of such compounds as ferro-silicon, calcium carbide, calcium silicide, graphite, nickel, etc., and advantage is taken of this fact in the production of high-duty irons by Meehanite, Nytensile, and similar proprietary processes.

The main function of these inoculants or ladle graphitisers is the control of structure by means of regulating the carbide balance, *i.e.*, the ratio of combined carbon to graphite, although the primary object in many cases is the elimination of chilling tendency in thin casting sections. Some inoculants, *e.g.*, calcium carbide and calcium silicide, promote a fine and uniform distribution of graphite, simultaneously imparting better strength to the metallic matrix. The tendency of ferro-silicon, however, is to promote growth of flake graphite at the expense of the matrix. Decomposition of inoculating compounds occurs in the ladle, and is accompanied by a vigorous exothermic reaction, usually associated with a scavenging action resulting in coagulation of slag, and a general refinement of grain size.

In this connection, it may be of interest to recall the work of Herty, Gaines and their associates at the Carnegie Institute of Technology, their conclusions being that the absorption of pure molten iron for oxygen is negligible at temperatures below 1,500 deg. C., but is markedly increased as superheating temperature is increased from 1,500 to 1,700 deg. C. The observed fact that overheated oxidised iron tends to undercool, and thereby produce the undesirable dendritic form of graphite, and the fact that silicon inoculation is known to destroy this dendritic pattern, is offered as evidence that silicon has acted as a deoxidiser in this case.

In practice, it is found that many factors influence the degree of effectiveness of inoculation treatment, chief of these being the nature of charge constituents, chemical composition, conditions of melting, degree of superheat, temperature of tapping, probably also the degree of oxidation or gasification of the metal, the inoculation technique at the ladle, and the period that elapses between inoculation and pouring. There is no doubt that the introduction of inoculation has proved a great boon to many grey-iron shops. At the same time, however, it is wise not to overlook the fact that wasteful, unscientific use of expensive inoculating alloys is apt to raise melting costs without a commensurate return in the form of improved quality of castings, or better machinability.

Superheating

As the name implies, superheating means the heating of metal to a higher temperature than is common in everyday practice. It is usually accomplished by heating in the electric furnace, although effective superheating has been claimed from cupola metal. As heat energy is expensive, the founder heats his charge for the shortest practicable time, and at the lowest temperature that experience has shown will provide satisfactory castings. There must be a good reason, therefore, for the adoption of superheating of cast iron, and it is found in the noticeable improvement in mechanical properties obtainable from superheated metal. When molten iron is heated above a temperature in the region of 1,500 deg. C., its constitutional behaviour on cooling differs profoundly from iron heated to normal temperatures, with the result that the iron is far less sensitive to changes in section, and is structurally entirely different.

Various theories have been put forward to explain the structural changes occurring in cast iron as a result of superheat, the one which received most favour being known as the "nuclei theory." This postulates that nuclei in the form of undissolved graphite, solid non-metallic inclusions such as sulphides of manganese and iron, complex silicates, and high melting point carbides act as nuclei in the melt, and initiate graphite formation at an early stage in the cooling, thereby promoting formation of coarse graphite flakes. Higher temperatures are said to eliminate these nuclei, with the result that the metal cools below normal freezing temperatures before solidification commences, and then proceeds at a very rapid rate, with the production of fine graphite. Recently this theory has been modified, the idea that undissolved graphitic carbon can form nuclei for crystallisation having been discarded. The nuclei are now thought to be provided solely by non-metallic inclusions, slag slimes, etc.

According to Di Giulio, excessive superheat is detrimental to cast iron, and he refers to the lowest temperature which produces detrimental or non-beneficial effects as the "critical superheating temperature." This temperature has been shown to vary with changes in composition, particularly that of the total carbon content. Piwowarsky found that tem-

(*Concluded on page* 2.)

NOTES ON OIL-SAND PRACTICE IN THE ORDINARY FOUNDRY

Oil-sand Plant—Mixing —Tests on Mixers— Design of Mixers

By WM. Y. BUCHANAN

(*Continued from page* 293.)

Oil-sand Plant

The plant arrangement referred to is shown in Fig. 3, showing the installation of a large-size Fordath mixer, handling a maximum batch of 1 ton adjacent to a storage bin of about 150 tons capacity of raw sand. The raw, damp or wet sand is discharged from a truck on a railway siding about 5 ft. above the level of the floor on which the mixer is placed, and the floor of raw-sand bin is about the same level as that of the railway.

A mild-steel hopper is constructed through the wall separating the storage chamber from that containing the mixer. This hopper, which rests on the edge of the mixer at a suitable angle for convenient emptying, is closed by a door at the discharge end. The capacity of this hopper was calculated to give a definite weight of sand when filled to overflowing and the exact weight got by filling carefully with weighed quantities of sand. By slightly adjusting the size of the hopper the present capacity is fixed at 1,932 lbs. (46 buckets or 92 galls.), and with the further addition of 150 lbs. rock sand and 60 lbs. Kordol powder binder to the mixer, the batch is made up.

The height of the floor in the storage chamber has been arranged to give a reasonable shovelling height to the steel hopper. A normal time for filling this hopper for a good foundry labourer would be about 6 min. The undried sand is dumped from the hopper into the mixer by releasing the door and the rock sand or binder added. The mixing is completed in about 2 to 4 min. after addition of the binder, and the emptying takes about 2 min. more, depending to some extent on the green-strength of the mixed sand.

The output is, of course, limited by the rate of filling the mixer and clearing away the mixed oil sand, but with this arrangement six batches can readily be handled in an hour. Since this rate is not required continuously, the stock of fresh oil sand can be got up quickly and the men switched to other work, such as distributing sand to coremakers. This arrangement also allows for future expansion of oil-sand practice, and also allows an adequate fresh supply of sand to be prepared immediately on starting and eliminating delay at the beginning of a shift when the demand is heavy.

Another reason for moving the mixing and storage of oil sand from the foundry to an outside station is that the "drying out" of sand in the foundry is a factor which limits the production of sand ahead of requirement. The action of this machine is extremely simple and this is a factor in its favour, particularly with reference to maintenance—that bane of the present-day foundryman's existence. The mixing is due to a rubbing or extruding effect between the end of the rotating arms and the vertical wall of the machine and, as the movement of the sand is not restricted in a vertical direction, it slips freely on the metal surface of the wear plates without any tendency to build on, and thus the wear is very low.

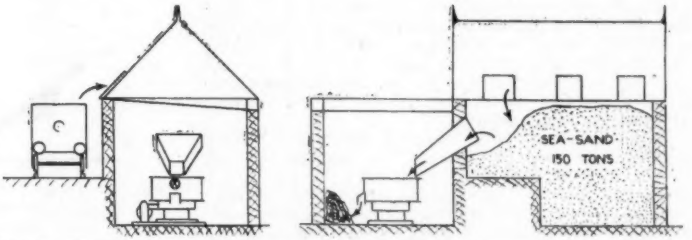

FIG. 3.—GENERAL ARRANGEMENT OF UNLOADING, STORING AND MIXING FACILITIES FOR OIL SAND.

The replacement of tips on the moving blades is sometimes necessary when a large piece of quartz has inadvertently been allowed in among the raw sand. The moving parts are few, but as in the case of all foundry machinery, the oiling should be carefully attended to, as most foundry breakdowns are due to failure of oiling systems either from neglect or clogging due to dust. Very wet sands, especially those containing appreciable amounts of clay, soon clog the metal surfaces and set up excessive friction and wear. On the other hand, a sand which does not stick to the metal, such as, for example, Irvine sand from a good source, will prolong the life of the wearing parts indefinitely.

Mixing

There are a number of mixers for oil sand based on several well-known principles; some of these are designed on the pug mill originally used for mixing fireclay, etc., in brick making. Others resemble the

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types of mixers used in breadmaking which employ a sort of stirring action suitable for very plastic materials. However, for large outputs of material like oil sand the question of wear of the moving parts becomes very important, and this factor tends to control the design to a considerable extent. The fact that a machine mixes material like dough does not mean that it is equally suitable for oil sand.

The author has found by extensive experiment that the pan mill is very efficient in dispersing any semi-solid core oil in sand, the mixing being attained by the rubbing of the grains over one another under the action of heavy rollers. The improved design of these types of mixers vary in detail, improvements being often centred round types of ploughs, scrapers or stirrers, the main object being to turn the sand more efficiently into the path of the rollers.

Some of these mills have a revolving pan and stationary rollers, a type which runs smoothly owing to its moving parts being balanced, while others have fixed pans and revolving rollers, the advantage of this type being that the opening in the pan itself for discharge of the milled sand can be fixed in a definite position, the action of the scrapers or ploughs being utilised to effect the rapid emptying of the pan. Pan-mill type of mixer, while being the most suitable for clay-bonded sand, is also quite efficient in making oil sand, although the filling and emptying of the mill must be effected mechanically for regular daily production, and this can be based chiefly on the machine designed for the purpose.

Among the specially designed machines of the paddle mixer type, the "Rotoil" is amongst the best known in this country, having been in use for a number of years. This machine depends for its mixing action on a series of rotating arms passing horizontally under a series of fixed blades in such a way that the sand is continually turned over and forced through a restricted space.

The sketches of Fig. 4 illustrates the movement of sand during mixing, and are taken from a pamphlet issued by the makers some years ago. The moving blade is shown in these sketches in sequence 1 to 4 as progressively moving a compressed wad of sand into the next heap, partly mixing, turning over and extruding the dispersed mixture under the second, stationary blade. This machine is undoubtedly very efficient and has given long service in ordinary foundry conditions, more particularly where the pan and blades are kept reasonably clean.

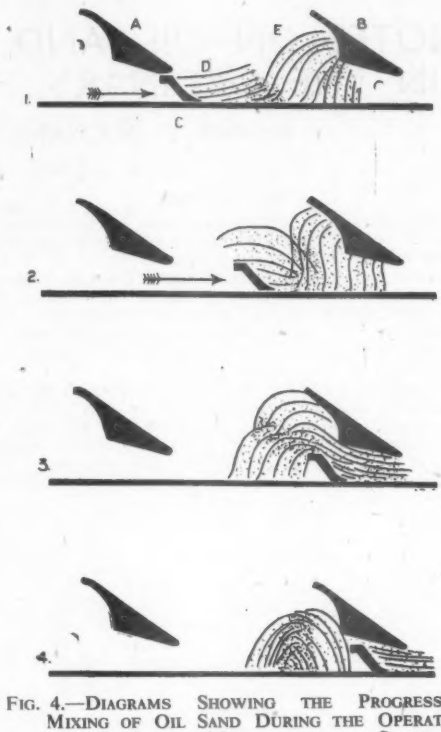


FIG. 4.—DIAGRAMS SHOWING THE PROGRESSIVE MIXING OF OIL SAND DURING THE OPERATION OF THE ROTOIL MIXER WHERE A SERIES OF ROTATING BLADES PASS UNDER STATIONARY BLADES.

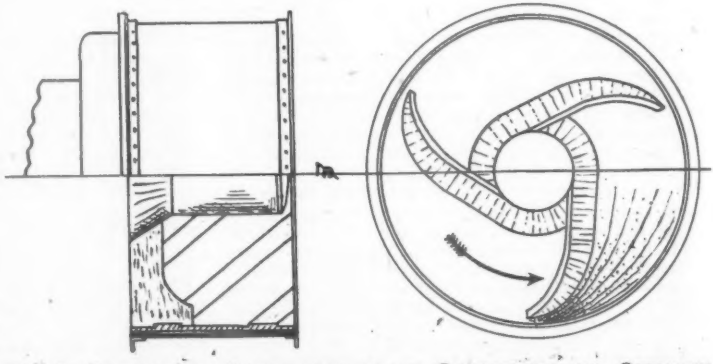


FIG. 5.—DIAGRAMMATIC ILLUSTRATION OF THE CONSTRUCTION AND OPERATION OF A NEW TYPE FORDATH OIL-SAND MIXER.

The firm responsible for these "Rotoil" machines has recently put on the market an improved mixer which has many advantages over other previous machines, mainly in the line of increased production. It is stated that the new type will mix 2½ times as much sand and compound in the same period as the "Rotoil" of the same diameter, that is, 10 cwts. as compared with 4 cwts. In the new type there is no minimum capacity as in the case of the "Rotoil." The latter must have at least 3¼ cwts. in the mixer before it functions, and its maximum quantity is 10 cwts., but the minimum quantity is unlimited.

Fig. 5 shows the new type Fordath mixer. The rotating arms are so shaped that the sand is continuously forced out to the side walls, where it is extruded through the small space at the end of the arms. The sloping ribs on the wear plates give an additional turning-over movement and the action is continuous and very thorough. The discharge in the new type is in the side of the pan instead of in the bottom, and the mixture is forced out by the blade instead of being left to the force of gravity to fall through a hole in the base. It is consequently more speedily and effectively discharged. As there are no overhead blades as in the case of the "Rotoil" upkeep expenses are far less.

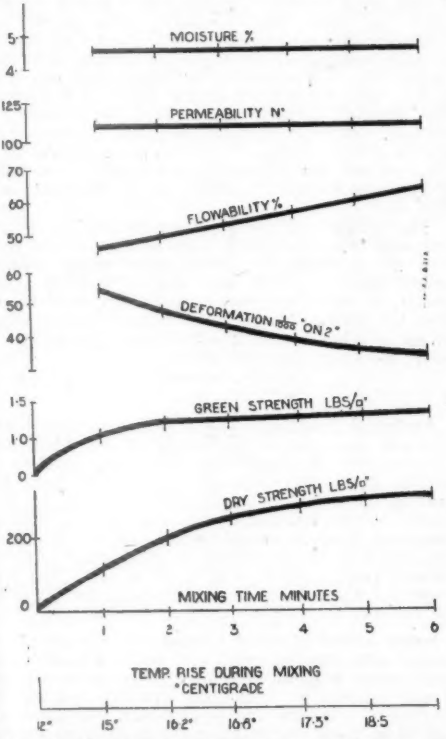


FIG. 7.—GRAPHS SHOWING THE CHANGES IN PROPERTIES OF THE BATCH OF OIL SAND MATERIALS DURING MIXING IN A NEW TYPE FORDATH MIXER, SIZE A.

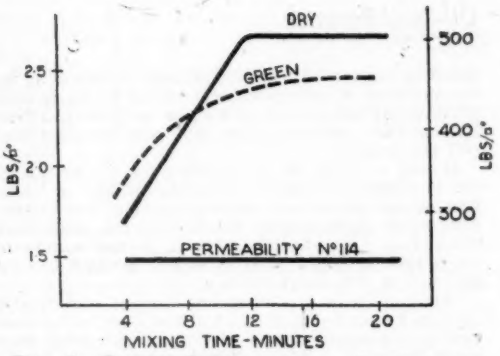


FIG. 6.—GRAPHS SHOWING THE CHANGES IN PROPERTIES OF THE BATCH OF OIL SAND MATERIALS DURING MIXING IN A ROTOIL MACHINE..

Some tests taken to determine the mixing efficiency of the "Rotoil" machine are given in the graphs in Fig. 6. This illustrates that the mixing is complete in about 12 mins., as determined by the dry strength curve. The green strength reaches a maximum at about the same time. The technique here was to use dry sand, add and disperse the binder, and then add water to bring up the bond. It should be noted that the rate of filling was rather slow so that the whole operation could not be repeated more than twice per 50 min. or so.

As indicated in the graphs the permeability does not change, *i.e.*, as measured on an A.F.A. test piece rammed in the standard A.F.A. rammer. For comparison a series of tests were carried out on the new type machine with a 2,140-lbs. batch. It will be observed from Fig. 7 that the maximum mixing efficiency is obtained in 4 min., but this time can be reduced as mixing goes on even during discharging, which may take a further minute and a half. Flowability and deformation as carried out by the author's own tests are included here as a matter of interest, since these properties seem to be claiming the attention of the trade at the present time.

It appears that the flowability as such increases as the binder is dispersed over the sand grains. Deformation decreases with increase in green strength, and there is evidently a distinct relationship between these tests, as indicated in previous papers. The author, after due consideration of the excellent work by Kyle, Ash and Lissell, and Dietert on development of a test

Oil-Sand Practice

for flowability is of the opinion that the test using the measurement of surface hardness made by single compression top and bottom of a 1¼ in. × 2¼ in. test piece has not been improved upon, and is at the same time still the simplest.

During compression or ramming of this test piece the movement of the sand grains includes a lateral flow as well as vertical. The question of rise in temperature of mechanically mixed sand has often been referred to. The figures indicated at the bottom of the graphs in Fig. 7 show a steady increase in temperature of the order shown.

The quantity of heat absorbed must be considerable since in this case the mass of about 1 ton of sand as well as the metallic parts of the machine have been raised 6 deg. in 5 min.! Whether air cooling would

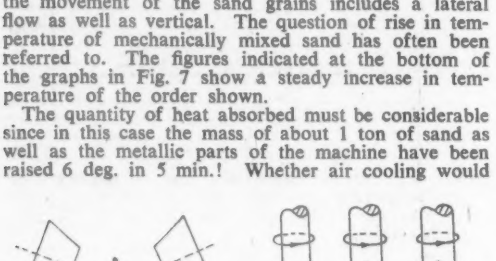


FIG. 8.—DIAGRAM SHOWING A DRILLING EXPERIMENT TO DETERMINE THE SHAPE OF THE COMMON CURVE BETWEEN THE STATIONARY AND ROTATING PARTS (TOP RIGHT).

FIG. 9.—THE REQUIRED CONICAL SHAPE OF ROLLERS IN A PAN MILL WHERE ROLLING ACTION ONLY IS DESIRED (TOP LEFT).

FIG. 10.—DIAGRAMMATIC ILLUSTRATION OF THE WEAR ON PAN MILL ROLLERS A AND PLOUGHS B.

be worth the extra expense or not is uncertain, but it is evident that the shortest possible mixing cycle is desirable.

Design of Mixers

The author recalls having heard, in passing, of an experiment said to have been carried by someone interested in mechanical engineering to study the wearing curve in rotating friction under heavy load, an experiment which appears to the author to have some direct bearing on design in mixing machines. At any rate it will serve for the present discussion on design. The experiment consisted of causing a steel rod or shaft pressed under heavy load against the surface of a steel block at right angles to the axis of rotation. During the experiment the point of the rod was observed to become progressively rounded (Fig. 8) until the shape of this curve became stabilised as the boring progressed.

After the curve had become stabilised the mutual wear on the rod and block went on steadily with surfaces in close contact over the whole of the curve. The mathematical formula for this curve is not known to the author, but this does not matter as it is likely to vary with the types of materials and probably with the diameter of the rotating cylinders or system. The general conclusion arrived at was that when the line of contact between heavily loaded parts was of the proper shape the wear efficiency of the parts would be at its best, and it is this thought which is of interest in connection with the subject under discussion here.

Wear Problems

Considering the normal operation of the pan mill rollers, it is obvious that to obtain rolling action of rollers on a small circle in a pan it would be necessary to have the rollers cone-shaped with both the apices located in the centre of the path of movement which, of course, is a circle, as is shown in Fig. 9. Any other form of roller must run in such a way that the outside of the roller is slipping, and this slipping varies in degree from the inside to the outside, and thus produces a progressive wear from the inside outwards. Practical observation of the wear on pan mill rollers shows a tendency to conform to the same type of curve, as is illustrated at A, Fig. 10.

The scrapers or ploughs specially adapted to clean the sand from the outside edge of the pan and turn it into the path of the rollers, come in for relatively severe wear, and these also tend to wear to a curve similar to the experimental illustration (B of Fig. 10). This has been recognised in America, where the shape of the pan has been altered to fill up the corner with heavy fillet and start off with a curve.

(*To be continued.*)

Technical Training.—The attention of foundrymen, who are interested in the impact of the White Paper "Educational Reconstruction" on their post-war industrial conditions, is drawn to two publications. One, bearing the title "Education and Training for Engineers," has been issued by the Institution of Electrical Engineers, Victoria Embankment, London, W.C.2, and the second by the Institution of Mechanical Engineers, Storey's Gate, London, S.W.1. Its title is "The White Paper on Educational Reconstruction and Its Impact on Training for Mechanical Engineering."

South Africa's Largest Casting.—"Iscor News" for August describes the making of South Africa's largest steel ingot, weighing 40 tons. The octagonal ingot mould weighed 47 tons and varied in section from 9 to 18 in. A brick and loam mould was constructed and basic metal from the mixer used, transported in a 60-ton ladle suspended from a 110-ton crane and tilted by using a 20-ton auxiliary hook. The ingot mould is thought to be the largest casting ever made in the Union.

NEW TUNG-OIL METHOD OF TESTING MAGNESIUM CASTINGS

A new technique in the impregnation of magnesium castings with tung oil, one of which seems advantageously applicable to production shops, has been developed by the Chevrolet Grey Iron Foundry at Saginaw, reports Mr. S. H. Brams in "The Iron Age."

The new method forces the oil through porous sections of castings under direct pressure rather than by autoclave vacuum process. When utilized in production runs, it saves much time over the previous method, and appears to be producing a more satisfactory job. The new method also appears to eliminate a considerable proportion of tung oil waste which has seemed inevitable in the past. Inasmuch as the method depends largely upon precise fixturing of the pieces, it does not appear adaptable to jobbing shops handling a wide variety of shapes.

Simple Procedure

Castings are brought to the impregnation department and heated to 175 deg. C. They are then placed in fixtures, which provide feed lines for tung oil into the casting cavities and also allow for overflow lines at the other end of the cavities. The piping of these fixtures brings tung oil, pre-heated to 100 deg. C., into the cavities. Oil is run into and through the cavity, driving all air out. The overflow valves on outgoing lines are then closed, bringing the oil to a dead end, which is under 90 lbs. pressure. The casting is held thus for 10 min. During that time any porosity in the casting will be manifested by a film of oil, which gradually appears on the surface of the metal after having seeped through from the inner cavity. Such porosity is common in magnesium castings.

After the 10 min. stay of the pieces in these fixtures, they are removed and put through a degreasing operation, which cleans the tung film from the exterior. They are then allowed to stand from 8 to 12 hr., during which the tung oil impregnation oxidises. The pieces are then taken to an oven, which is brought slowly up to 175 deg. C. temperature during a 2-hr. period and held at that level for 4 hrs., during which the tung oil further oxidises. Any "fry" which cakes on the outside of the casting is then sandblasted off and the piece is sent to a dichromate solution, which further cleans it.

This completes the operation, the casting then going to machining. After machining, the piece is further tested under 250-lb. pressure, a customary step under any system of impregnation. If porosity is then manitested, a second impregnation is usually attempted by the machine shop, either by the vacuum system or by simple soaking in tung oil or silicate of soda. If porosity is still evident after this second impregnating attempt, the casting is scrapped.

The fixtures utilised at the Chevrolet Grey Iron Foundry are simply constructed. They are built primarily of pipe with the fittings made air tight by the use of old rubber belting cut into gaskets. Operation is hydraulic with the line under shop pressure clamping the pieces tightly into place. The entire set-up is so simple that the most complicated casting can be placed to receive the tung oil within 2 min. or so.

The impregnating department at Saginaw has nine fixtures, one for each type of casting now being produced. Three more mixtures of each type will be employed, now that the system has been proved and adopted.

Comparison with Earlier Methods

This new method appears to provide noteworthy improvements over the old system where production runs are involved. Generally accepted methods of impregnation up to now revolve around one developed several years ago by Dow Chemical Company. This method has been to create a vacuum ranging all the way from 22 to 28 in., as the user sees fit, in an autoclave chamber in which a tray of castings has been placed. This exhausts air in pores of the casting. Tung oil is then flowed into this autoclave tank in sufficient quantity to cover the castings. Air pressure of 100 lbs. or so is then introduced and held from 35 min. to 1 hr., depending on user's technique, as a means of forcing the tung oil into any porous areas. This basic method is being used to-day in many American plants which have used up their supplies of tung oil and are leaning on substitutes like silicate of soda or others developed by individual companies.

In these orthodox autoclave methods, pieces are then removed to a kerosene rinse. They are next taken to a tank of hot engine oil electrically heated to 245 deg. C., where they remain for 45 min. to set the tung oil. Another kerosene bath follows to remove the engine oil residue, and in this second bath the tung oil is soaked off the casting exterior and interior. Decreasing operations follow, and then comes the bake at 175 deg. C., to oxidise the tung oil and to impede frying out.

The time cycle in this latter type of operation is obviously lengthy, but it still appears to be the most satisfactory means where a variety of pieces must be handled. Where shapes are uniform, as in a production shop, notable time savings are involved with the new Chevrolet technique.

The old method also uses up considerable quantities of tung oil which has been in consistently smaller supply. There is considerable loss in the cleaning operations which intersperse the major steps in the process. The new method evolved by Chevrolet utilises comparatively little tung oil, inasmuch as any flow through the overflow valves drops on to a table and goes into recovery tanks.

Although the new system has been operating only a short time, actual impregnation appears more satisfactory than in the older method. Positive soaking of the casting with the sealing tung oil is accomplished and is visually evident, and this has resulted up to now in a much greater proportion of castings passing the first impregnation test at 250-lb. pressure than ever before.

NEWS IN BRIEF

SHEFFIELD METALLURGICAL ASSOCIATION will hold its annual general meeting on Saturday, January 15, at the Metallurgical Club, West Street, Sheffield.

THE GENERAL COUNCIL of the Trades Union Congress, at a meeting in London, decided to support the principle of a world trade alliance after the war.

MESSAGES FROM LA PAZ state that the new President, Señor Gualberto Villarroel, has pledged Bolivia to continue exporting her tin output only to the United States and Great Britain.

ZINC INVESTMENTS, LIMITED, have considered suggestions that some part of the capital be returned to shareholders. The directors have formulated a scheme which they anticipate submitting to the shareholders in the near future.

DURING THE PAST YEAR the employees of the Mirrlees Watson Company, Limited (engineering and foundry departments), subscribed towards infirmaries, convalescent homes, the Red Cross and other institutions a sum amounting to £897.

"FORMENT," A FIREPROOF material claimed to be superior to asbestos, has been produced in Germany. It is said that it can be cast and moulded, does not affect metals, and on heating does not emit poisonous gases. It has a melting point of 1,700 deg. C.

A LECTURE on a chemical engineering subject has been endowed by Mr. J. Arthur Reavell, and will be given under the auspices of the Institution of Chemical Engineers. The lecture will be known as "The J. Arthur Reavell Lecture," and will be delivered not less frequently than once in every four years.

THE NEXT MEETING of the West Riding of Yorkshire Branch of the Institute of British Foundrymen will be held at the Technical College, Bradford, on Saturday, January 8, at 6.30 p.m., when two short Papers will be read by Mr. G. W. Nicholls on "Research and Development," and by Mr. J. Stott on "Is the Chemist really necessary in the Foundry?"

MR. A. CALLIGHAN, general secretary of the National Union of Blast-furnacemen, Ore Miners, Coke-workers and Kindred Trades, in a circular to lodge delegates and officials, says that once again he can report no stoppage of work during a whole year. Every point of difference which has arisen has been settled across the table and with the maximum amount of goodwill on both sides.

APPRENTICES IN CLYDESIDE engineering and shipbuilding shops are agitating for a scheme of training that will make them more efficient journeymen. Some establishments have a comprehensive scheme in operation, but the youths maintain that with some employers the five years' apprenticeship is served in one or two sectionalised departments, and that youths entering the industry have no opportunity of gaining all-round experience.

SPEAKING at the annual meeting of J. Brockhouse & Company, Limited, West Bromwich, Mr. J. T. Brockhouse, chairman and managing director, said the directors had been giving close attention to the recruitment and training of personnel, and had further extended their plans, which should ultimately provide a very comprehensive educational and training scheme. For some years in the larger works the firm had established classes for apprentices, with specially qualified teachers. Specialised courses are provided for managers and foremen, and to enable the firm further to implement the scheme the board desires to found three scholarships at Birmingham University in order to pass a certain number through the established university course.

NEW YEAR HONOURS

The following names, appearing in the New Year Honours List, are of interest to the foundry trade:—

Knights Bachelor

MR. G. E. BAILEY, works director, Metropolitan-Vickers Electrical Company, Limited.

MR. E. H. COOPER, chairman and managing director, Gillette Industries, Limited.

MR. W. PATERSON, chairman and managing director, Paterson Engineering Company, Limited.

MR. A. H. RAILING, chairman and joint managing director, General Electric Company, Limited.

MR. C. S. SWAN, chairman, Swan Hunter & Wigham Richardson, Limited; director, Glasgow Iron & Steel Company, Limited.

C.B.

COL. W. H. WIGGIN, vice-chairman, W. & T. Avery, Limited.

C.B.E.

MR. W. W. HACKETT, a director of Engineers & Ironfounders, Limited.

COL. H. B. SANKEY, Midland Regional Controller, Ministry of Production; director, Guest, Keen & Nettlefolds, Limited; managing director, Joseph Sankey & Sons, Limited.

O.B.E.

MR. A. KEATS, joint managing director, Fisher & Ludlow, Limited.

MR. E. J. LOWE, director and works manager, Thos. Firth & John Brown, Limited.

MR. A. C. BROOKS, works manager and engineer, M. & W. Grazebrook, Limited.

MR. C. HOLMES, departmental manager, Thomas Firth & John Brown, Limited.

MR. W. MACDONALD, chill foundry manager, International Alloys, Limited.

MR. F. WORTON, assistant works manager, Brown Bayley's Steel Works, Limited.

British Empire Medal

MR. E. J. KELLY, foundry foreman, Brown Lennox & Company, Limited.

MR. C. K. PANTING, grinder, fettling department, John Dale, Limited.

Save Fuel
in your CUPOLAS
by using
STANTON
SAND-LESS
Machine Cast
PIG IRON
THE STANTON IRONWORKS COMPANY
LIMITED NEAR NOTTINGHAM

PERSONAL

MR. JOHN BALMAIN, of Leven, has been appointed manager of Hillside Foundry, Cupar, Fife.

COL. S. M. TATE, joint managing director of the Chesterfield Tube Company, Limited, has returned to England after a business visit to the United States and Canada.

MR. JOHN TAYLOR, for many years director and vice-chairman of Mather & Platt, Limited (he retired from active association with the firm in 1942) celebrated his diamond wedding on Christmas Day.

MR. NORMAN ILES has been appointed Director of Plant Progress in the Iron and Steel Control, Ministry of Supply. He succeeds Mr. Frank Parr, who has been appointed Steel Commissioner to the Government of India.

MR. JOHN VARLEY, who for 23 years was secretary of the Coventry and District Engineering Employers' Association and director for a short time before his retirement last March, has been presented with an illuminated address.

MR. J. W. DAVIES, who has been elected president of the Manchester District of the Engineering Employers' Association after two years' service as vice-president, is a director and general works manager of Ferranti, Limited, the Hollinwood firm of electrical and general engineers.

MR. ALAN P. GOOD, in view of his many outside obligations, has asked to be relieved of his responsibilities in connection with the subsidiary companies of Heenan & Froude, Limited, other than Fielding & Platt, Limited. The opportunity has been taken to modify and strengthen the boards of Heenan & Froude, Limited, and its subsidiaries where necessary. The following changes have been made:—Mr. Alan P. Good has resigned from the boards of Court Works, Limited, Caprotti Valve Gears, Limited, Associated Locomotive Equipment, Limited, and Jones Gas Process Company, Limited. Mr. James Fielding, managing director of Fielding & Platt, Limited, and Mr. W. M. Good have been appointed additional directors of Heenan & Froude. Mr. W. M. Good has been appointed a director and chairman of Caprotti Valve Gears and Associated Locomotive Equipment, and a director of Court Works and Jones Gas Process Company. Mr. G. M. Gill, managing director of Severn Valley Gas Corporation, Limited, has been appointed chairman of Jones Gas Process Company. Mr. W. M. Ratcliffe, managing director of Heenan & Froude, has been appointed chairman of Court Works. Mr. James Barclay is resigning from the board of Jones Gas Process Company, and Messrs. P. A. A. Gooch and C. E. New from the boards of Caprotti Valve Gears and Associated Locomotive Equipment.

Wills

SKINNER, SIR HARRY ROSS, of Aboyne, Aberdeenshire, consulting engineer	£51,829
MACPHERSON, W. W., of Leeds, mechanical engineer, former managing director of Fairbairn, Lawson, Combe Barbour, Limited	£28,960

NICKEL PRODUCTION AND CONSUMPTION

STEEL INDUSTRY'S TAKINGS

Mr. Robert C. Stanley, chairman and president of the International Nickel Company of Canada, Limited, in his usual year-end statement, says that the output of nickel in the Sudbury district of Canada, where the most important known nickel deposits are located, has in recent months dropped 10 per cent. below peak production, due to the effects of shortage of labour in Canada and to having to use many new and inexperienced workers. Nevertheless, the demands of the United Nations war programme for nickel have been met, the control of distribution by Governmental authorities in Ottawa, London and Washington having mastered what appeared to be a critical supply situation. These authorities have also made use of the scrap materials which had accumulated within industries that were producing war equipment.

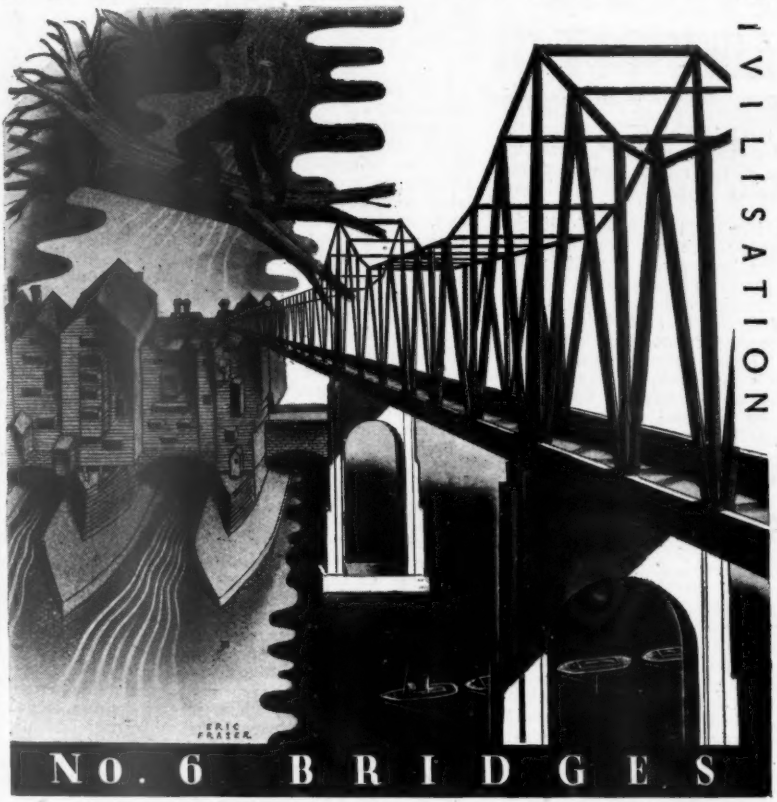
It is estimated that the United Nations' consumption of nickel in 1943 will prove to be nearly double that used by those countries in the pre-war peak year. Steel mills are currently taking over 70 per cent. of the new nickel made available. Many changes have been made in specifications which govern production and use of a lowered nickel content. Through these changes, the applications and markets for nickel alloy steels have become broadened. The company this year neared completion of its extensive war expansion programme. Through this plan, capacity has been increased by about 50,000,000 lbs. of nickel per year over the 1940 output; the entire expansion, costing approximately $35,000,000, is being financed with the company's own funds.

OBITUARY

MRS. A. B. WILLIAMS, a director of Chamberlin & Hill, Limited, ironfounders, of Walsall, died on December 29. A daughter of the late Mr. Henry Hill, one of the joint founders of the company, she entered the business in 1894, and worked untiringly for its welfare until ill-health compelled her to take a rest last March. From 1903 until 1933, Mrs. Williams and the late Mr. Bather, were the joint directors, and since that date Mrs. Williams had acted in a similar capacity jointly with Mr. H. F. Bather.

MR. S. W. WISE, the popular honorary secretary of the West Riding of Yorkshire Branch of the Institute of British Foundrymen, died suddenly on December 24. He was an outstanding success as a branch official and after seventeen years his work was last year acknowledged by the award of the Institute's Meritorious Service Medal. He was largely responsible for the success of the Bradford Conference held under the presidency of Mr. J. Hepworth, M.P., in 1928. Though born in Leamington, he spent a number of years on Tyneside before settling down in Yorkshire. His great organising ability will long be remembered and appreciated by a very wide circle of foundrymen.

FUNDAMENTALS OF CIVILISATION



NO. 6 BRIDGES

THE UNITED STEEL COMPANIES LTD

The origin of the bridge is lost. Was the first bridge a fallen tree, torn from its roots by the tempest and flung across the torrents. Did stone arches evolve from some linking of stepping stones with stone slabs in time of flood? Development was slow because of the limitations imposed by materials. The result was, however, the picturesque timber structure and the graceful stone arched bridge. Such bridges, aided movement by land but were a hindrance in the waterways because their spans were, of necessity, short.

Steel revolutionised construction and enabled the engineer to leap across the widest river. In this present age the cantilever, suspension, arched span, plain girder, lattice girder, swing, transporter and reinforced concrete bridges all depend on steel and all facilitate communications between communities which is the essence of civilisation.

THE UNITED STEEL COMPANIES LIMITED

STEEL, PEECH & TOZER, SHEFFIELD
SAMUEL FOX & CO. LTD., SHEFFIELD
UNITED STRIP & BAR MILLS, SHEFFIELD
APPLEBY-FRODINGHAM STEEL CO. LTD., SCUNTHORPE
WORKINGTON IRON & STEEL CO., WORKINGTON
THE SHEFFIELD COAL CO. LTD.
THE ROTHERVALE COLLIERIES, TREETON
UNITED COKE & CHEMICALS CO. LTD.
THOS. BUTLIN & CO., WELLINGBOROUGH

U.S.P. 30

Company Meeting

HALE & HALE (TIPTON), LTD.

MR. W. EDGAR HALE'S SURVEY

The seventh annual general meeting of Hale & Hale (Tipton), Limited, was held at Dudley on December 30, MR. W. EDGAR HALE, J.P., T.C., M.I.Mech.E., M.Inst.F. (chairman and managing director), presiding.

Moving the adoption of the report and accounts for the year ended August 4, 1943, the Chairman said:—

I feel that I should like to tell you of all the interesting happenings with which our company has been concerned during the last year, but such is not allowable for reasons of which everyone is aware. The sum total of our activities will bear comparison with any undertaking of similar characteristics.

Life in the twentieth century cannot be based upon "manna from heaven." It can only be based upon honest endeavour. How is our company to serve the future? In the first place we are engaged upon producing a raw material in universal demand, which will rightly claim a much larger field in the future as a result of the very fine performance during the wartime emergency, when it has been called upon to replace many items in both cast and forged steel and has given a most excellent account of itself. Its very extensive usage has been general practice in the United States of America for many years, and I have not the least doubt that engineers in future will specify for its usage much more so in this country than hitherto. There is an immense new field open to the industry at home in the future.

In the second place, we are equipped with a first-class plant capable of producing in great volume material possessing physical and mechanical properties that will satisfy the most fastidious of engineers. Our Blackheart Malleable Iron Castings are already used by almost all the best engineering houses to-day, and we are anticipating great increases. I, therefore, look forward with great interest to the future in the certain knowledge that Hale & Hale (Tipton), Limited, is going to fill an ever-increasing niche in post-war times and will bring prosperity and satisfaction to all concerned.

New Directors

During the year changes have been made in our directorate. Mr. T. L. Hale has resigned owing to ill-health, and we have appointed Mr. Coe, our very able secretary, to the board, and Mr. Wylde, who has been filling a very important office on the sales side and co-ordinating his work with the production side.

You will be interested to hear something of what has happened during the year with the two associated companies, namely, Chatwins, Limited, and J. & J. Whitehouse (Tipton), Limited, and I am pleased to inform you that both these schemes have contributed very handsomely indeed to the great efforts which our company has made during the year. In both instances their normal peacetime activities for all practical purposes have had to cease and the entire effort has been devoted to national service. Both companies have a good peacetime record which should reflect well in the post-war era.

Wartime Taxation

The trading result for the year, after taxation has been taken into consideration in its varying and complicated forms, leaves the company with approximately the same margin as of recent years, and is likely to continue to remain approximately the same as long as taxation remains as at present. In the latter connection the drain upon liquid assets is more than, in my opinion, it is possible for industry to continue with and at the same time remain healthy. Apart from taxation, wartime trading conditions of themselves absorb liquid capital on a grandiose scale, and I am convinced that the Exchequer will ultimately have to come to the aid of industry in some form or other to remedy the evil before post-war industry will be able to be established upon a satisfactory and secure foundation. We are left with a net profit of approximately £16,000 which, together with the balance brought in, makes a total of £27,500 or thereabouts to be dealt with.

Preference dividends absorb nearly £3,000 and a dividend of 10 per cent.; which it is proposed should be paid, absorbs a further £5,000. It is then proposed that £2,500 shall go to general reserve, which will round off the total of that reserve at £30,000. It is also proposed that a further £7,500 shall be reserved to cover future taxation, leaving a balance to be carried forward of approximately £10,000.

Your directors feel that in slightly increasing the ordinary dividend they are justified in so doing, although it means a slight divergence from the very conservative policy adopted hitherto. The market value of the company's ordinary shares has remained steady throughout the year and, upon the assumption that industry as a whole in this country is going to be successful (and it would be an incredible thought that it should be otherwise), I think that they are likely to prove of interest to those investors who are interested in steadily developing commercial enterprises.

The Balance Sheet

A general glance at the balance-sheet reveals on the assets side that land and buildings are slightly down. Our machinery and plant is up by approximately £10,000, representing expenditure on capital account during the year, and in this connection I would say that our plant and properties are maintained at a good standard of efficiency. The smaller items remain roughly as hitherto. Our investments appear at a total of approximately £24,000, represented in the main by shares of Chatwins, Limited, and J. & J. Whitehouse (Tipton), Limited, but no dividend has been received on those shares, as your directors have decided, in agreement with the company's auditors, upon a policy which does not render desirable those unnecessary transactions.

The stock is up somewhat, and the debtors are

NO. 10 PREPARED BLACKING

● The Latest Core and Mould Wash for IRON CASTINGS

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STEELMOL

for STEEL and SPECIAL IRON CASTINGS

HIGH CARBON BLACKING
CEYLON PLUMBAGO
TERRA FLAKE · COAL DUST · GANISTER AND
ALL FOUNDRY SUPPLIES

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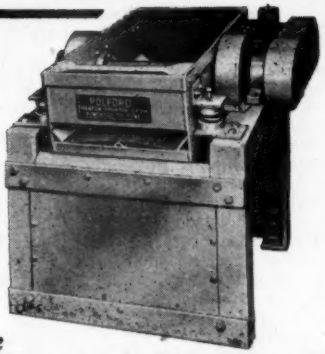
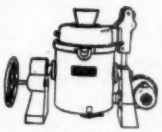
PHŒNIX WORKS & PLUMPTON MILLS, PENISTONE, near SHEFFIELD

Telephone : PENISTONE 21 and 57
Telegrams : BLACKING-PENISTONE

HANDLES UP TO 10 TONS PER HOUR



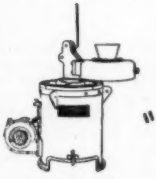
The **LAST WORD** *in Screens* **—FIRST** *of its kind!*



TILTING FURNACE

Exceptionally high speed in screening is one of the many striking features of this unit, used in conjunction with sand conditioning plant. The machine shown above has a 20" × 40" screen and can handle up to 10 tons per hour. The screen vibrates both horizontally and vertically. Rotation is opposite to the direction of the feed to give cleaning action to the mesh. This unit will run for long periods without attention. Built in various sizes according to requirements.

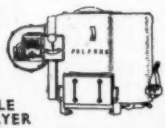
Write for prices and details.



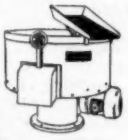
CRUCIBLE FURNACE

"POLFORD"
Vibratory Screen

Other **"POLFORD"** *Products*



PORTABLE MOULD DRYER



CORE SAND MIXER

THE HEATON FOUNDRY CO., LTD.

Makers of Foundry Equipment,

HEATON JUNCTION, NEWCASTLE UPON TYNE, 6

slightly down and the loan to H.M. Treasury has been repaid. On the liabilities side the sum total of the reserve, with the additions proposed, now exceeds £50,000. The total of creditors of all kinds has been reduced by some £13,000.

Tribute to Chairman

Mr. W. Clarkson, in seconding the adoption of the report and accounts, said:—

I want to take advantage of the opportunity presented to express our appreciation and thanks to our chairman and managing director, Mr. W. Edgar Hale, J.P., for his work and guidance during the year just reviewed. We are indeed fortunate in having a managing director who is not only endowed with extraordinary business acumen, but who also possesses expert practical and technical knowledge of our particular trade. The prodigious output we have maintained of "Hales Blackheart M.I. Castings" for the major war services is in no small measure due to his foresight and understanding. His outstanding work has benefited the country equally as much as the company.

It will be noticed that Mr. R. C. Leppington has been appointed vice-chairman of the company. It was my very pleasant duty at our first annual meeting to express then my appreciation of Mr. Leppington as our sales manager, since when he has been appointed general manager, and now vice-chairman, and as these positions have been granted, not on account of seniority only, but ability, I am sure you will join me in congratulating him on his further advancement in his career.

The report and accounts were adopted, and resolutions confirming the payment of dividends and the re-election of the retiring directors were duly passed. The proceedings concluded with a vote of thanks to the chairman and directors.

NEW COMPANIES

("Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.)

A. Norris & Sons (Wireworks), 32-34, Victoria Road, Leeds—£5,000. G. H. L., R., L. and N. Norris.

Pudsey Welding Company—£2,000. S. C. Burn and E. J. Nield, 23, Smalewell Road, Pudsey, Yorks.

Caves (Redditch), Evesham Road, Ashwood Bank, Redditch—Engineers. A. Cave and W. J. Young.

Royston Engineering Company, 2, Elton Road, Kingston-on-Thames—£2,000. R. A. J. Hill and J. G. Leech.

Godding Engineering Company, 5, Castle Street, Caerleon, Mon—£1,000. A. Godding and C. G. Davies.

Southern Screws, 73, Basinghall Street, London, E.C.2.—Engineers, etc. £1,000. F. W. and V. A. Mulcare.

John G. Ironside & Company, Syston Foundry, Wanlip Road, Syston, Leics—Engineers, founders, etc. £1,000. J. G. Ironside.

COMPANY RESULTS

(Figures for previous year in brackets)

John Holroyd & Company—Profit to September 30 last, after E.P.T., £58,297 (£51,878).

James Cartland & Son—Net profit, after tax, for year to March 31 last, £3,339 (£926); forward, £10,274 (£6,935).

Sydney S. Bird & Sons—Net profit to September 30 last, £8,369 (£8,462); dividend of 30% (same); forward, £7,506 (£6,637).

Jonas Woodhead & Sons—Net profit to August 31 last, £18,891; ordinary dividend of 10% (same); forward, £17,514 (£16,753).

Wheal Reeth Tin—Loss for 1942, £392; unpaid debenture interest for year, £1,440; debit brought in, £25,553; debit forward, £27,385.

Gascoignes (Reading)—Profit, after tax, £7,843 (£7,227); dividend of 15% (same) and a bonus of 5% (nil); forward, £13,778 (£13,435).

C. Lindley & Company—Net profit, after tax, for the year to September 30 last, £9,421 (£9,791); final dividend of 15%, making 25% (same).

Tarran Industries—Loss for year to September 30, £13,932 (profit £36,088); interest, etc., £24,231 (£22,962); dividend of 5% (10%); forward, £16,699 (£61,960).

David Brown & Sons (Huddersfield)—Profit to September 30 last, £206,739 (£564,649); tax, £111,780 (£484,870); contingencies, £50,000 (£100,000); dividend of 10% (same); forward, £242,520 (£234,001).

Aston Construction Company—Trading profit for the year ended September 30, £13,260; depreciation, £2,041; net profit, £11,220 (£11,699); preference dividend, £1,050; to taxation account, £2,000; dividend of 2½% on the ordinary shares; forward, £17,735 (£11,691).

Birfield Industries—Dividends received to November 30 last, £77,076 (same); tax repayment, £889 (£423); net profit, £75,445 (£75,320); preference dividend, £27,750 (£27,900); capital redemption, £10,000 (same); ordinary dividend of 12½% (same), £16,562; reserve, £20,000 (£10,000); forward, £43,980 (£43,347).

Joshua Bigwood & Sons—Net trading profit, after tax, for year to September 30, £20,417 (trading profit £81,805, less tax £61,000, leaving £20,805); depreciation, £7,293 (£7,854); war damage contribution, £679 (£1,265); net profit, £11,395 (£13,472); preference dividend, £3,240 (same); ordinary dividend of 10% (same); forward, £7,594 (£3,189).

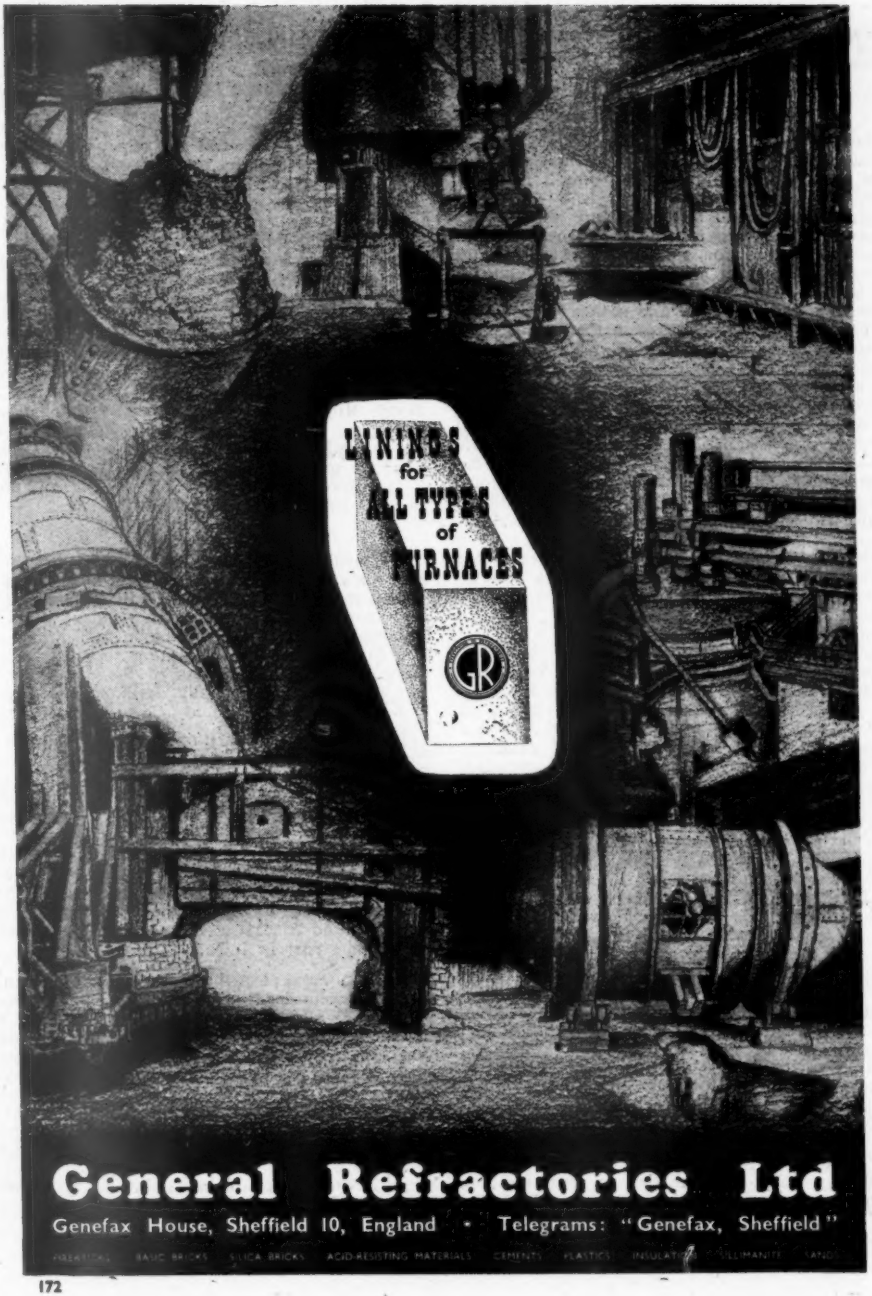
NEW TRADE MARKS

The following applications to register trade marks appear in the "Trade Marks Journal":—

"CONFLEX"—Testing machines for engineers, machine tools, and machine parts. PULTRA, LIMITED, 24, Gravel Lane, Salford, 3.

"NOCOHEAT" (and Device)—Stoves. E. S. ROWLANDSON, trading as NATIONAL ECONOMY STOVES (1941), Cross Street, Neston, Cheshire.

"CUTANIT"—Tungsten carbide tips, and tools and dies incorporating tungsten carbide tips. CUTANIT, LIMITED, 14, Finsbury Circus, London, E.C.2.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for
ALL TYPES
of
FURNACES
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General Refractories Ltd
Genefax House, Sheffield 10, England • Telegrams: "Genefax, Sheffield"
BASIC BRICKS SILICA BRICKS ACID-RESISTING MATERIALS CEMENTS PLASTICS SILLIMANITE
172

Raw Material Markets

IRON AND STEEL

The holiday period has served to accentuate transport delays and indirectly this has emphasised the value of keeping stocks in hand. There is plenty of iron awaiting delivery and, as scrap is by no means abundant, foundries and steelworks are using rather larger proportions of pig-iron in their furnace charges. Hematite is reserved for special purposes, but the severe restrictions which have been imposed upon its use are less irksome now that it is possible to obtain more liberal supplies of low- and medium-phosphorus irons. The pronounced slackness in the light-castings trade and the more recent decline in activity at the engineering and allied foundries have reduced the demand for high-phosphorus iron below normal and stocks are accumulating.

That scrap deliveries are not in every case equal to the needs of consumers is a not uncommon state of affairs at this season, even in normal times, owing to the short daylight periods and weather conditions, while in wartime the black-out intensifies the difficulties in the collection, sorting and delivery of scrap. Coke is in plentiful supply.

Finished iron makers began the new year with much brighter prospects. There has been a run on bars of late and many of the makers are not anxious to increase their commitments.

Re-rolling plants are working to capacity and have heavy commitments extending over the first and second periods of 1944. Necessarily, their consumption of semis is on a very heavy scale, but deliveries from the steelworks have been so satisfactory that of late it has been possible to preserve stocks of imported material almost intact. Supplies of defective billets and double-sawn crops are readily absorbed, but there is a good deal less interest in defective sheet bars, for which it is difficult to find a market.

Steel plates bulk largely in the rolling programmes for the first half of the coming year, and all users have to indicate delivery dates well in advance. But abnormal pressure is not restricted to the plate mills. Demand for light angles, small bars, flats, rounds and squares is scarcely less urgent, while the extending utilisation of sheets for a wide variety of purposes has created a demand with which it is difficult to cope. The bulk of the sheet output is still being supplied black or painted, but a little more spelter has been released for galvanising. Considerable tonnages of steel are consumed by the collieries for maintenance and extension work. Regular tonnages are allocated to them and up to now supplies have been quite adequate. Largely the quota is taken up in roofing bars, arches and rails, although many other classes of steel are wanted in the collieries.

MR. WILLIAM H. MOSELEY, of Highgate Road, Walsall, died recently. He carried on business for many years as an ironfounder in Bath Street, Walsall.

NON-FERROUS METALS

As from January 1, the price of tin sold by the Non-Ferrous Metals Control has been increased by £25 per ton. The price for metal of minimum 99 per cent. up to under 99.75 per cent. tin content is now £300 per ton and all other prices have been varied correspondingly.

The old price of £275 had been in operation since December 9, 1941. Since that date there has been a general upward movement in the cost of tin to the Ministry of Supply resulting in a substantial burden on public funds at the present price, and the increase now announced takes account of the present and anticipated level of costs of the supplies from the different sources available to the Ministry while the present abnormal conditions in the Far East continue.

Holders of licences to purchase tin granted on or before December 31, 1943, can, on application to the Joint Controllers, Non-Ferrous Metals Control, Grand Hotel, Rugby, cover themselves by purchases, where they have not already done so, against such licences up to and including January 8, at the Ministry of Supply's selling prices ruling on December 31.

The other non-ferrous metals present no fresh features of outstanding interest.

THE REGISTRATION is announced of a new company, Electronic Controls, Limited, of which the directors are all members of the board of the Electric Furnace Company, Limited. The latter company was the first to introduce high frequency melting and heat-treatment into Europe, and the application to numerous metallurgical and other purposes of the thermionic valve, which is now being rapidly developed, largely owing to war requirements, should lead to interesting results.

THE GOVERNMENT OF INDIA has appointed Mr. Frank Parr to the post of Steel Commissioner. His duties will include the co-ordination on behalf of the Government of the working of the various authorities dealing with iron and steel. He will also centralise and maintain statistics in standardised form in regard to the production and utilisation of iron and steel. Mr. E. D. McCallum has been appointed to assist him in organising the statistical work. Mr. Parr has vacated the position of Director of Plant Progress in the Iron and Steel Control, Ministry of Supply, to take up the post in India.

FALKIRK MOULDERS have been successful in their claim for increased piece rates. The dispute was between R. & A. Main, Limited, Gothic Works, Camelon, Falkirk, and members of the Ironfounding Workers' Association. It arose out of a claim that when engaged on moulding plough metal the percentage payable on such work should carry an award of 7½ per cent. agreed between the National Light Castings Ironfounders' Federation and the Joint Committee of Light Metal Trades. The National Arbitration Tribunal have found in favour of the claimants, the award having effect as from the beginning of their first full-pay period following December 15.